ADDRESS BY

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As Delivered

SPACE AND HUMAN VALUES

Introduction

Dr. Lindaman, members of the faculty, and students of the graduating class of 1970. It is a great privilege to be allowed to share in this eventful day for Whitworth College and for my good friend Dr. Lindaman. Commencement is an exhilarating experience and as I well remember at the University of Washington where I graduated--a great relief! And also a time of fond farewell, to friends who last as "best" friends for the rest of your life. And finally, a time to look forward and to project your own future, the future of your nation, the future of Earth, and now (although barely) the future of the universe. I don't plan to give to you the inspirational message which your distinguished President can give so much more competently than I can with respect to the philosophical aspects of space as it affects your life, but I would like to relate to you some of the parallels in circumstances of today's graduating class, and of your alma mater, and the Space Program of the United States, of which I am a part.

With today's commencement, you have accomplished a set of objectives and reached important goals, all of which will be abruptly replaced by a new set of objectives and new goals which now lie before you. Whitworth College shares in your achievement, and yet already it must anticipate the beginning of another undergraduate cycle,

and look to its ever-increasing responsibilities to its students and the academic community.

The space program is much the same. The National Aeronautics and Space Administration accomplished the national objectives set nearly a decade before when men from planet Earth, two U.S. astronauts, Neil Armstrong and Edwin Aldrin alighted on the magnificently desolate surface of the moon last July. In a sense, that landing on the moon was the graduation ceremony of the space program. Your diploma today attests to your readiness to proceed with your efforts to advance the objectives of society. The diploma conferred upon the space program by the President of the United States is now on the lunar module left on the moon and says "We came in peace for all Mankind." It recognized that this nation was ready to undertake more advanced objectives in space for the benefit of mankind.

Many of you in your newly won degree status will be joining with others in the field of education, in church-related pursuits, in government and business, as part of a team to help carry out one of various human endeavors. The space program is also a team effort by groups of individuals doing myriad tasks. Today, more than 140,000 persons in industry, government, and the academic community (many in the State of Washington) are on the space team that

numbered more than 400,000 at the peak of the Apollo Program effort in 1966.

As your academic career has been a major and highly visible undertaking in the eyes of your family and the faculty of Whitworth College, so has been the development of capabilities for the exploration of space a major and highly visible undertaking in the eyes of the nation and the world. And perhaps as a parallel to your own experience as students, the results of the space program have been measured on a scale that seems to proclaim a passing grade is not always good enough. I am sure you gladly accepted the academic challenge, as the space agency welcomed the research and development challenge of opening space to the people of earth.

While the United States, through its space program, has literally been learning how to operate in space, as even the latest moon flight demonstrated, there has been no moratorium on results as this nation developed and tested its spacefaring machinery and skills.

Space Values and World Change

It is surely the hope of each of you that you will help to shape your community, your state and nation, and even your world. It is my belief that so long as you hold this objective, you cannot but succeed, because the impact of your efforts will be felt. In my judgment, the nation's space program also will succeed in the future as it has in the past,

not only because we have carried out manned flights that took us to the moon, and unmanned flights to the vicinity of Mars, but because our space efforts are exerting a profound change upon this nation and the world in many wonderful ways.

Much has been made of the U.S. missions which have sent highly trained men soaring through the weightless void of space to accomplish specific space flight tasks. These missions have been reported on a world-wide scale as no other single events in modern history. From my responsibilities in the aerospace industry and in the manned space program, I am aware that the overall impact of developing the capability to carry out such missions has served to benefit mankind immensely. The public, however, has, in perfectly human fashion, been drawn to and has applauded these spectacular space feats, while less glamorous scientific and technological accomplishments generated by space flight have been quietly accepted or overlooked entirely.

The average citizen is acutely aware of the dramatic achievements of the space program. However, he has not grasped the significance of the overwhelming benefits and values derived from this great undertaking. I am reminded of a statement attributed to Dr. Edward Teller as he compared the potential practical value of space exploration to the voyage of Columbus. He said, "When Columbus took off, the purpose of the exercise was to improve trade relations with China. Now that problem has not been solved to this very day, but just look at the by-products."

The truth is that civilization has been changed by the phenomenon of space flight, both socially and scientifically, both academically and esthetically. The changes are evident in our teaching as well as our technology. Because the impact of space pervades all human endeavor, it will be worthwhile for us to reflect on some of the changes that have occurred because of our national space effort.

Social Change

It is impossible to gauge the full extent of the human values of new horizons and of new hope for a better world that have resulted from the space program. You are perhaps familiar with the frequent observation that our flights to the moon have demonstrated that men and women of competence and good will can work together within our institutions to achieve almost impossible goals. I am aware of the vast differences and varying degrees of difficulty in achieving various goals of society. In my view, the problem of getting to the moon was easier to solve than many others that are still with us. Yet the space program did marshall some old-fashioned human responses and some tremendously effective management systems to reach its goal of the 1960's, and these inspiring achievements are a valid spur to the National will in other segments of this country's endeavor. Certainly the space effort has provided methods and encouragemen to tackle the tremendous social problems around us.

In addition to raising the horizons of man's aspirations, the space program also clarified man's relationship to the universe and to his fellow man. Flying out a quarter of a million miles into space, man for the first time in his history has been able to see himself and his planet in true perspective. Now, through the Apollo flights, mankind perceives the earth as one entity rather than many many political subdivisions. At the same time, man sees the earth as one small but precious blue gem in the cosmos rather than the center of the universe.

In 400 B.C. Socrates said, "We who inhabit the earth dwell like frogs at the bottom of a pool. Only if man could rise above the summit of the air could he behold the true earth, the world in which we live." Archimedes more than 2,000 years ago had wished "to stand poised in space" that he might view the earth. Yet in the twentieth century Einstein also imagined "an observer freely poised in space." Now, after these millennia, man has reached a vantage point in space from which to view his mother earth. I am convinced that our vantage point in space, the viewing of our "blue gem" in the Cosmos, triggered our sudden responsiveness to the cry for pollution control.

Your distinguished President has observed in his writings that man's ability to see himself and his blue planet will impact every discipline one could name, and will find its

way into the thinking of every man concerned with designing the future. He has also noted that a deep moral perspective is needed today to assure that this country's endeavors in space are useful to humanity and not merely technological spectacles. I believe those among you who are becoming teachers must be farther ahead in sensibility and awareness than the industrialist or the engineer, to point out the true significance of our new perspective to the youngsters growing up in the era of space exploration applications.

Space flight, of course, had an immediate impact on education with the launching of the first earth satellite in 1957, the Soviet Sputnik. This first space exploit led to a national reassessment that provided a new impetus to learning for the educators and students of this country--an impetus which pervaded all levels from the earliest grades to the graduate school. Your class from early grade school on, received that impetus. The impact of space has also exerted a moral force, a striving for excellence in the quest of knowledge, that has helped to reshape the entire educational process.

While the U.S. space program has changed the outlook of our citizens, the openness of this country in exploring space also has had its influence upon the peoples of the world. I believe that Apollo 11 brought the people of the world together as never before in history, sharing the oneness of mankind and

a pride in the achievement of the crew as members of the human race.

More recently, international unity and concern were generated by the difficulties encountered during the flight of the Apollo 13 spacecraft modules Aquarius and Odyessy on the way to the moon. Indeed, the flight of Apollo 13 was a true odyessy, which Webster defines as "an adventurous journey marked by changes of fortune." The changing fortunes of Apollo 13 rallied the peoples of the world to pray for the crew's safe return, and prompted many nations of different political ideologies, including the Soviet Union, to offer their assistance in recovery operations.

Technological Change

The technology which allows our astronauts to venture 250,000 miles from earth was all but taken for granted by the time we flew Apollo 13. Actually great technological advances were needed to develop the aerospace equipment which can carry man reliably around the earth, and outward into new regions of the solar system. The new systems have to perform under conditions once deemed prohibitive, thus casting space in the role of a forcing function for innovation. The space program is actually serving as a cutting edge of technolgy today, and the space developments of the 1970's will extend this function into the future. In addition to the visible space vehicle systems, are advances in the form of new

materials, new processes and techniques, and the advances in computers, communications, and data handling.

The impact of new space requirements on the computer industry provides an excellent example of space stimulated progress. The exploration of space demands very large computer systems of great complexity, size and speed, plus new flexibility in the use of computers. Such uses include automated checkout for space hardware, real-time monitoring of space missions, aircraft and spacecraft simulator controls, computing planetary trajectories, and modeling global weather patterns. During Apollo missions, on a real-time basis, computers calculate the trajectory to the moon and back, compare three separate solutions for the lunar descent, record and analyze thousands of bits of telemetered spacecraft information, compare these to predicted values to detect trouble, and at the same time monitor the well-being of the crew. To illustrate how the space program's computer needs have grown, the Mercury computer program contained forty thousand "computer words" while the Apollo computer program needs one and a half million, 37 times more than Mercury. The computer industry has met this challenge.

The economic impact of space should not be overlooked, either. Using the computer example again, the U.S. computer industry does about $8 billion worth of business a year and U.S. computer exports have increased 1,400 percent in the

first decade of the space age. Industry spokesmen credit the stimulus of space program requirements and space agency support of technological advances for this record. So not only did the space agency get full value from the computers it paid for, but the entire nation is benefiting from the economic and technological contributions of this industry.

The examples of technological progress made through the space program are seemingly endless, in electronics, in materials, and hundreds of other areas. Let me cite just a couple in connection with the automotive industry, perhaps more closely related to our daily lives.

In order to meet the new Clean Air Act, the Chrysler Corporation reworked its automobile ignition systems, designing distributors to operate within much closer limits. To assist in this they called in their own people who had developed the automated checkout and launch sequence equipment for the Saturn rocket that launches the Apollo spacecraft on its journey to the moon. Today, at the Chrysler Indianapolis plant, every distributor is dynamically tested for final acceptance, on computer-controlled equipment derived directly from the Apollo program checkout equipment.

Another example is an automotive safety device which originated in the shock absorber that is used today on the couches in the Apollo spacecraft. The device is rugged, cheap, resettable, and reuseable. The Bureau of Public Roads

has tested it in connection with highway guard rails and found that it cuts down a 60 mile-per-hour impact to the equivalent of a 5 mile-per-hour. Ford Motor Company is now working to incorporate this Apollo device into its automobile bumpers, perhaps on its 1972 models. Allstate Insurance Company already has announced collision premium reductions of 20 percent for cars so equipped.

Medical Change

Turning from aerospace technology to medicine, the biomedical field offers another example of how the nation's space program has impelled change which benefits every citizen. The relatively few manned flights already made have produced enough knowledge to create entirely new concepts of medical procedures and equipment.

Whether the astronauts are flying 200 miles above the earth or a quarter of a million miles out in space, the space agency needs to know how fast their hearts are beating, how much oxygen they are using, how their muscles are reacting to the stresses imposed by their tasks in a weightless environment. In every manned flight, information from a biosensor attached to the body of the astronaut is relayed to a computer, to data screening equipment, and through the space program communications network to the medical team at the Manned Spacecraft Center in Houston. You can be sure that during the first steps on the moon, the Apollo 11 astronauts received considerable attention.

The motive of the space agency in developing the monitoring system was to preserve the lives of the astronauts, but countless other lives are being saved as a result. A recent adaptation of this system is being used in many cities to increase the efficiency of hospitals. Radio-equipped ambulances transporting a heart attack victim use biosensors with spray-on electrodes to transmit an electrocardiogram to the emergency staff so that when the patient arrives both staff and equipment stand ready to administer the indicated treatment. At the hospital, the space-developed electronic sensors for monitoring astronauts now have been adapted to continuously measure the pulse and respiration rates, temperature and blood pressure of up to 64 patients and provide continuous display of the information at a central control station. This single development gives promise of revolutionizing hospitals throughout the world. The same sensors, incidentally, can be used to monitor a patient after he has returned home by communicating an electrocardiogram to his doctor by telephone.

Partially paralyzed patients or paraplegics can now operate a motor-driven wheel chair, turn the pages of a book, change a TV station or call for help--all with a switch which can be operated by eye movement. This switch operates

on the principle of infrared reflection from the eyeball which was developed for use by the astronauts when high gravity forces might limit arm and leg movement.

Growth of Scientific Knowledge

Space related science is, of course, not confined to the laboratory. The growth of scientific knowledge afforded by our various space missions is, in fact, one of the primary values being returned by our national efforts in space. And it is very heartening to see our young people taking such an avid interest in this knowledge and in the scientific concepts we use to gather it. I am reminded of Christmas Day 1968 when the Apollo 8 spacecraft was zooming back toward earth faithfully obeying the laws of gravity and action/reaction after its historic moon-orbiting feat. Astronaut William Anders was relaying information back to earth when a ground controller mentioned that his young son had asked him who was "driving" the spacecraft. After a brief pause, Anders replied, "I think Isaac Newton is doing most of the driving now".

Moon and Planets

The discoveries from Apollo 11 and 12 have taught us more about the moon than we had previously learned in our entire history. We learned more about Mars from the pictures sent back by the automated Mariner spacecraft last summer than we had previously learned since the invention of the telescope.

We might ask if in the process we have subjugated romance to science--the "mysterious moon", the "canals" of Mars. Yes, but we have opened the mysteries of the universe. This newly acquired knowledge of the moon and other planets is helping us to understand more clearly both our own planet and the universe. The moon, in particular, has long been thought to have great potential for interpreting the history of the solar system. Since the surface of the moon has been spared most of the processes of change that occur on earth such as erosion, folding, and cracking, the record of its long history since the formation of the solar system some 4.5 billion years ago apparently has been preserved.

Astronomy

Space astronomy is giving astronomers powerful new tools for investigating challenging questions. Huge radio galaxies, quasars, pulsars, and numerous X-ray sources are still unexplained. This country's space satellites are providing the means for making observations in the radio, infrared, ultraviolet, X-ray and gamma-ray wave-lengths that cannot penetrate the earth's atmosphere. When we recall that our present day knowledge of nuclear energy stemmed from inquiries into how the sun produced its radiant energy, we can speculate that today's space astronomy may eventually also yield results of tremendous practical importance.

Earth Resources

Space photography and earth sensors enable us to study the earth and its atmosphere in detail, to search for new resources, to monitor water resources, agricultural activity, and to explore the oceans.

A photograph taken by Gemini of the Western Desert of Egypt was examined by an Egyptian geologist working at the University of California. He saw photographic evidence that mineral deposits in this area (which he personally knew) were at least four times as large as earth-bound research had shown.

An earth fault, amazingly similar to faults in the oil-rich Arabian Peninsula, show up in space photos in Northeast Africa where oil has not yet been found. Considering the high cost of oil prospecting, it seems logical to expect that oil companies may use space investigation as a more economical means of finding oil deposits.

Yet we have just begun to fully realize the vast potential that earth resources satellites have for the betterment of life here on earth.

We now know that observations from space can answer the basic questions that must be answered if we are to make efficient use of the limited resources of our own planet. What causes ocean currents? What untapped food resources are in the sea? What is the status of food crops around the world? Where is the flood potential of snow

cover in our mountain ranges? And of prime importance, what and where are the sources of air and water pollution?

Meteorology

Perhaps in the field of meteorology we find the most dramatic example of how our space program is providing direct benefits to the man in the street. Early in the space program, new tools and information systems for weather forecasting were developed and put into operation. These included satellites to track storms, measure wind, record the temperature at different heights, and report on the moisture content of the atmosphere.

The first satellite merely took pictures of the clouds. Now, satellites take pictures not only in the visible light, but also in infrared, and show clouds during the night as well as in daylight. Last year a satellite was launched that could take the vertical temperature profile through the atmosphere. This year, the second satellite of this type was launched, with even more sophisticated instruments. Previously it had taken tons of thousands of balloon soundings to get the same information--information that is vital in long range forecasts.

Our weather satellites have the ability to detect and track major storms, hurricanes, and threatening weather patterns, early enough and precisely enough to permit timely warning and decision. Hurricane Camille, last August, was

first observed and then tracked by satellite. The hurricane's path, force, and extent were predicted early and accurately enough to permit authorities to evacuate some 70,000 people from the Mississippi and Louisiana Gulf Coast. It is estimated that some 50,000 people might have perished in the devastating storm without early warning and without the credibility provided by actual satellite pictures and data.

United States weather satellites have watched every major storm threatening the nation since 1966. In 1969 alone, 12 Atlantic hurricanes, 10 Eastern Pacific hurricanes, and 17 Western Pacific typhoons were identified and tracked by satellites. In fact, we now have available the first atlas of Pacific cloud and weather patterns covering the period 1962-1969, assembled from data available only by satellite. The Navy uses weather satellite pictures for ice patrols and to schedule Antarctic resupply, and airline pilots at Kennedy Airport routinely receive weather photos of their transatlantic route.

One other point to remember about these weather satellites is that they are inherently global systems. By using automatic readout systems, every nation in the world can benefit from the systems onboard U.S. weather satellites. Over 50 countries are now using our satellites to view daily weather patterns over their own territory--a fine example of how the use of space encourages international cooperation.

Communications

In the field of communications, we also have seen how the use of satellites has served to draw the world closer together and promote global cooperation. Today, communication satellites supplement cable, radio, or microwave links and literally interconnect every part of our world.

The INTELSAT satellites, controlled by an international consortium, have a capacity of 1,200 two-way telephone circuits or 4 color TV channels. Before satellites, a West Coast-to Japan cable circuit cost $15,000 per month; today, satellites have reduced the charge of this service to $4,000 per month. Newer, more advanced satellites, to be launched next year, will increase this capacity to 5,000 two-way circuits for transoceanic traffic, providing economical links across the Atlantic, Pacific and Indian Oceans.

One of the more far-reaching effects these satellites will have for the betterment of man is in the field of educational television. In 1973, the United States and India will cooperate in an unprecedented experiment using a space satellite to bring instructional TV programs to some 5,000 Indian villages. This experiment will be the first large-scale test of instructional television to demonstrate the potential value of effective mass communications in developing countries. India will be solely responsible for the television

programming which will be directed toward such subjects as family planning and improvement in agriculture.

I would like to mention a pleasant aspect of the development of our communication satellites. The COMSAT Corporation, where U.S. commercial communications interests are pooled, has for several years now ordered its own custom-made satellites and has refunded the space agency for launch services. A true pay as you go status has been achieved where the taxpayer's help is no longer required.

Benefits From Future Programs

My discussion of the impact of space would not be complete without looking briefly at some of the future national programs planned for this decade. Today, the country's manned space effort is moving toward multiple programs and away from one single objective as in the 1960's and we are doing it with lower budgets. Our space program for the next decades will be a balanced program composed of reasonable schedules and will be a program responsive to our nation's many competing social needs. The new programs emphasize economy and additional uses of space technology for the benefit of man. These are in addition to the Apollo lunar science program to be completed in the first half of this decade.

The first of these programs is Skylab, which will place an experimental space station in extended earth orbit beginning in late 1972. Skylab will provide the first opportunities for

a laboratory environment in space, allowing us to learn more of the earth's resources and the sun's energy. Crewmen will visit the laboratory for one to two months using the Apollo spacecraft for round-trip transportation. The laboratory itself is a modified Saturn rocket stage. Saturn launch vehicles will be used to launch the workshop and the crew separately. This program is based on using Apollo hardware not required for the lunar program.

The reuseable space shuttle, which combines performance characteristics of the airplane and the rocket, is a new development that will offer many economies and benefits later in the decade. The shuttle will be launched into space vertically with its own rocket engines, but will return to earth from space for a horizontal, airplane-type landing on a conventional airport runway. The space shuttle will reduce the cost of payloads by allowing retrieval or repair of satellites in orbit and the transportation of cargo and passengers to and from orbit. It will have a quick response time and significant space rescue capability. Its design will provide for 100 or more flights without major overhaul.

Another new program is the space station, planned for operations in the late 1970's or early 80's. In earth orbit, the space station supplied by the reuseable shuttle will provide additional economic gains and practical benefits. The station will reduce operating costs by its long life, up to 10 years in

earth orbit, and its flexibility, combining many operations such as research, applications, and support of space flight operations. It will be designed so many of the crew of 12 people on board will be able to carry out their technical tasks without special flight training. The space station modules may be used in various earth orbits, and ultimately, in lunar orbit or on a planetary mission.

The operation of the space shuttle and the space station will put this country into space operations considerably advanced from today's missions. They will permit a major expansion in the flexibility of space activities and a steady increase in the number of visitors into space. It is possible that someone in this audience could be among those flying up to the space station of the not too distant future. The expanded and more economical flight activities made possible by the space shuttle and space station will open space to a broad range of public, private and international interests.

Progress is expensive--there is no question about that. The programs that I have described when added to the continued forward thrust of the unmanned programs, will cost about $17 per person next year. But the tobacco bill is about the same, and the liquor bill is $24 per person! But I'll guarantee space will yield more for you and your children than a cough or a hangover.

Conclusion

While most of my discussion today has focused on the changes that are taking place throughout our daily lives as a result of the national space program, it is tempting at this commencement to ponder the direction of the future. That space and human values are irrevocably linked in many ways has already been established. Yet, in my judgment, it would be impossible for me today to predict accurately the future impact of space on your lives. In 1915, the airplane was 12 years old, the same age as the space program is today. Could we have predicted in 1915 what the future of the airplane would be when enemy aviators in open cockpits were just emerging from the era of saluting each other as they flew by on their reconnaissance flights to the era of throwing bricks at each other. I can say with certainty only that the full impact of this country's progress in the space environment has yet to be felt or even predicted. Magnificent as some of our accomplishments in space have been, they must, in the long run, be considered but a mere beginning. What we learn tomorrow will be of much greater consequence.

Following the flight of Apollo 11, Neil Armstrong very eloquently summarized the first lunar landing mission and theorized on its significance when he stated, "We hope and think that this is the beginning of a new era, the beginning

of an era where man understands the universe around him, and the beginning of an era where man understands himself."

Inevitably, as this nation continues the conquest of space, the knowledge gained will enhance the lives of those who receive degrees here today. To an even greater extent, it will enhance the lives of your children, and the lives of future generations on this planet and elsewhere on the frontiers of outer space.

Perhaps the finest note of all was struck by Buzz Aldrin during his return trip from the moon when he read to the listening world from the Eighth Psalm of the Old Testament. "When I consider thy heavens, the work of thy fingers, the moon and the stars, which thou has ordained; what is man, that thou are mindful of him?"

Thank you.